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FOREST RESOURCES OF NORTHERN MONTANA

FOREST SURVICE
NORTHEASTERN FOREST
EXPERIMENT STATION

by

C. W. Brown & W. C. Hodge

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Prepared by the Division of Forest Economics

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Paul D. Kemp was in charge of the compilation phase, prepared the volume tables, and determined the statistical accuracy of the resource data.

Clarence W. Brown supervised the photographic interpretation and field work. Assisting him were William Hodge, Thomas Finch, Melvin Metcalf, Elwyn Peffer, Willard Fallis, and Ronald Schulz. Office compilation of the data was done by the above men.

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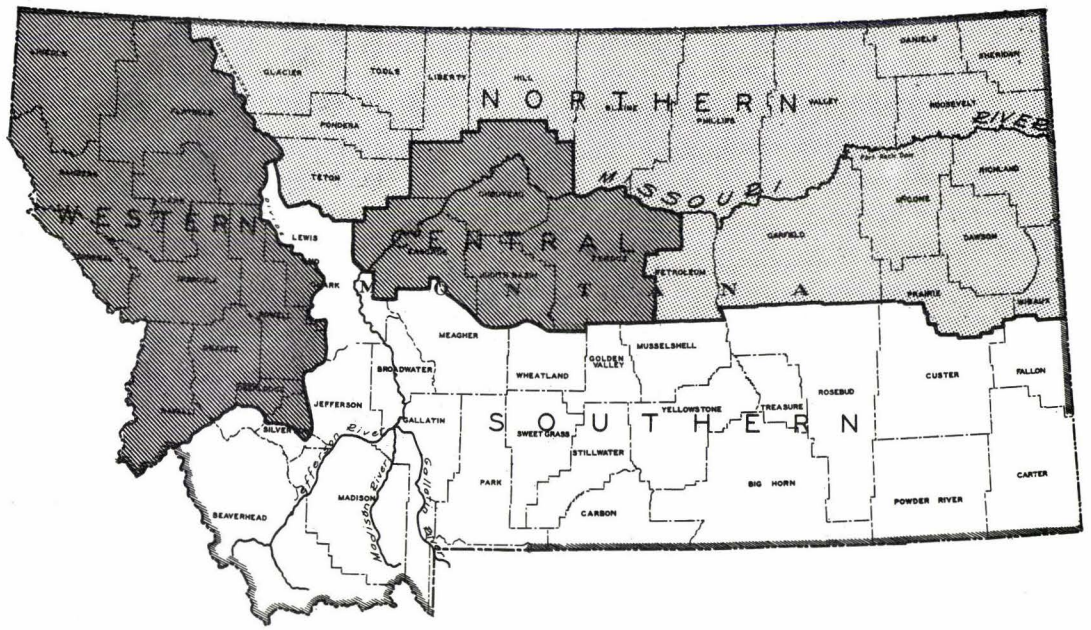
THE FOREST SURVEY IN MONTANA

A survey of Montana's forests was begun in 1934 as a part of a Nation-wide inventory of the forest resources. Interrupted by the war, this survey was resumed in 1946 and is now about 80 percent complete. Present plans contemplate finishing the survey in 1949 to give Montana the first real measure of its forest wealth. Statistics for four counties in Central Montana and for that portion of the state west of the Continental Divide have been published previously.

This report presents basic inventory data on the extent of the forest land and the timber volume for 19 Northern Montana counties as indicated on the map below. These counties were covered by the forest survey between April 1947 and January 1948. A survey of Southern Montana is now under way. Upon completion of the survey, a comprehensive report, including data on forest growth and drain, is planned for all of the units.

FOREST SURVEY UNITS



AREA COVERED IN THIS REPORT

AREA COVERED IN PREVIOUS REPORTS

FOREST LAND

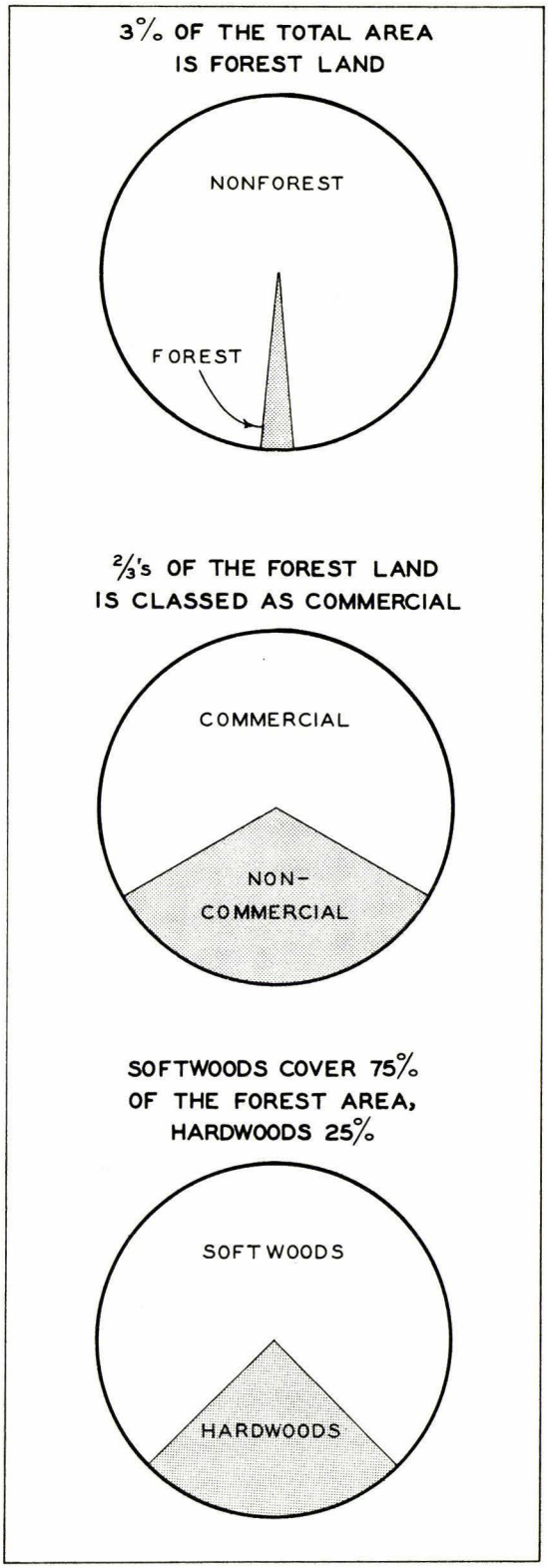
Northern Montana has nearly one million acres of forest land and lies largely in the Northern Great Plains region. Only 3 percent of the 31.7 million acres of land in the 19 Northern Montana counties is forested.

Though not extensive, the forests of Northern Montana have had an important place in the development of the plains country and are a significant factor in protecting part of the upper Missouri River watershed. In the frontier days, the cottonwood forests along the Missouri were the principal source of fuelwood for the river steamers coming to Fort Benton. Then later, hand-hewn ties from the Northern Montana forests were used by the transcontinental railroads as they pushed westward. More recently, though, the recreational and watershed values of these forests have increased appreciably.

The western portion of Northern Montana, including part of Glacier National Park and the Sun River Primitive Area, is rugged and massive with a number of snow-capped peaks. From these the prairie country extends eastward to North Dakota. Three isolated mountain ranges stand as forested islands in the prairie. They are the Bear Paw Mountains, the Little Rockies, and the Sweetgrass Hills. The major streams in the northern counties which originate within forested drainages are the Milk, Marias, and Teton — all tributaries of the Missouri River.

All of the 19 northern counties have some forest land. Glacier County, with 400,000 acres of forest land, has the largest forest area. Teton is second with 236,000 acres. In contrast are McCone and Roosevelt Counties, each with less than 1,000 acres. Table 1 gives the forest area by counties.

The forests of Northern Montana can be divided into three broad groups:



THE RIVER BOTTOM HARDWOOD FOREST

The hardwood type occurs in narrow strips or stringers along the Missouri, Marias, Milk, Teton, and Sun Rivers and their tributaries. Cottonwood is the principal species. Many of the river bottom cottonwood trees average about 24 inches in diameter at breast height and run two logs in height. To date utilization of the hardwoods has been limited to local uses: fuelwood, and ranch construction lumber. There are, however, some commercial possibilities for producing lumber, crating material, excelsior, and veneer.

THE SEMIARID PONDEROSA PINE FOREST

Scattered stands of ponderosa pine occur along the breaks of the Missouri River in Blaine, Phillips, Petroleum, and Garfield Counties and also on the outslopes of the Bear Paw Mountains in Hill County. Most of this pine grows under semiarid conditions and extremes of climate. As a consequence, the timber is short, scrubby, and of low commercial value. It is used locally for fuel, posts, and lumber.

THE WESTERN MOUNTAIN FOREST

This forest, typical of the Northern Rocky Mountains, consists mainly of lodgepole pine, spruce, Douglas-fir, and alpine fir. Most of the timber lies on the east slope of the Rockies in Glacier, Pondera, and Teton Counties. There are also small patches in the Bear Paw Mountains, the Little Rockies, and the Sweetgrass Hills. Most of the timber cutting in Northern Montana has been in this forest type, supplying fuelwood, posts, poles, mine timbers, and other products for local use. These forests were the site of early day tie-cutting operations.

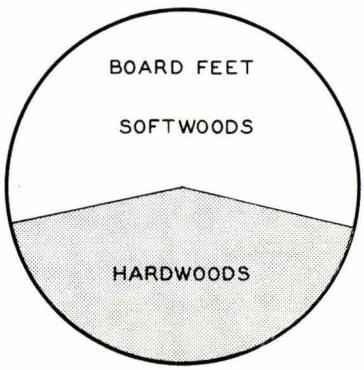
TIMBER VOLUME

The coniferous forests so typical of Montana decrease as they extend eastward. In the Northern Montana unit hardwoods in stringer type make up a major part of the forest area and volume. Six hardwood species occur: cottonwood, aspen, elm, willow, green ash, and boxelder. Cottonwood is by far the most common, both from the standpoint of distribution and volume. Aspen occurs throughout the unit but the largest concentration is in Glacier, Blaine, and Hill Counties. Only small volumes of the other species are found.

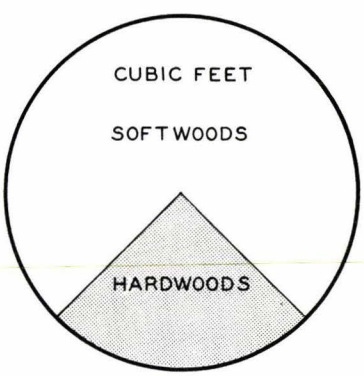
Nine species of conifers grow here: ponderosa pine, spruce, lodgepole pine, Douglas-fir, white bark pine, limber pine, alpine fir, juniper, and alpine larch. However, only the first four listed above are important from a volume standpoint.

Altogether there are nearly 600 million board feet of saw timber on commercial forest land in Northern Montana. Forty-two percent of the volume is cottonwood, 18 percent spruce, 18 percent Douglas-fir, 9 percent lodgepole pine, and 13 percent miscellaneous species. About one third of the saw-timber board-foot volume is in trees 20 inches and larger, whereas on a cubic-foot basis such trees make up only about 14 percent of the total volume. Because of the poor growing conditions — short season and low rainfall — the board-foot volume per acre of forest land is comparatively low throughout the unit. However, because of the general scarcity of all timber in these counties, utilization of existing timber supplies is good except in remote mountainous areas. Approximate timber volumes by counties are shown in table 2.

SOFTWOOD SPECIES MAKE UP 57% OF THE Bd. Ft. Vol.



¾'s OF THE Cu. Ft. Vol. IS SOFTWOOD



COTTONWOOD IS THE PRINCIPAL SAWTIMBER SPECIES

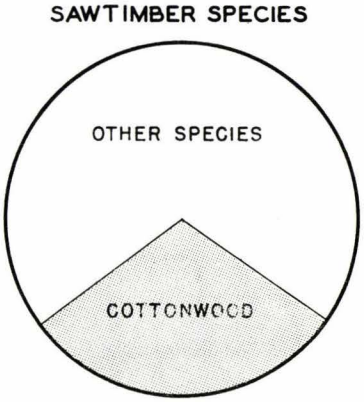


Table 1. Forest land area

County	Total area 1/	Total forest land	Commercial forest land		
			Total	Softwood	Hardwood
			-Acres-		
Blaine	2,730,880	87,400	80,872	80,475	397
Daniels	923,520	3,193	3,193	-	3,193
Dawson	1,509,120	7,112	5,952	1,275	4,677
Garfield	3,067,520	69,611	69,611	69,211	400
Glacier	1,903,360	399,825	110,519	22,039	88,480
Hill	1,884,160	7,929	7,929	3,280	4,649
Liberty	933,760	5,573	2,809	2,026	783
McCone	1,688,320	635	635	-	635
Petroleum	1,064,960	22,668	22,668	22,330	338
Phillips	3,368,960	29,098	26,559	14,429	12,130
Pondera	1,051,520	71,064	60,474	50,439	10,035
Prairie	1,105,280	2,170	2,170	-	2,170
Richland	1,321,600	5,889	5,889	-	5,889
Roosevelt	1,526,400	765	765	-	765
Sheridan	1,088,000	1,538	1,538	-	1,538
Teton	1,468,160	235,826	189,925	187,868	2,057
Toole	1,257,600	13,282	13,282	8,539	4,743
Valley	3,252,480	14,300	14,300	3,760	10,540
Wibaux	568,960	5,436	5,436	950	4,486
Total	31,714,560	983,314	624,526	466,621	157,905
Percent of total	100.0	3.1	100.0	74.7	25.3

1/ 1945 U. S. Census of Agriculture

Table 2. Timber volume

County	Saw timber 1/			All timber 2/		
	Softwood	Hardwood	Total	Softwood	Hardwood	Total
	M board feet			M cubic feet		
Blaine	59,273	1,562	60,835	26,238	332	26,570
Daniels	-	42	42	-	233	233
Dawson	-	6,032	6,032	-	3,369	3,369
Garfield	20,920	543	21,463	13,773	181	13,954
Glacier	735	48,985	49,720	4,809	15,218	20,027
Hill	3,426	2,791	6,217	1,603	2,125	3,728
Liberty	-	3,550	3,550	1,039	820	1,859
McCone	-	3,494	3,494	-	774	774
Petroleum	5,904	37	5,941	3,798	69	3,867
Phillips	4,702	26,860	31,562	7,660	8,701	16,361
Pondera	55,230	57,713	112,943	29,313	14,578	43,891
Prairie	-	11,939	11,939	-	2,644	2,644
Richland	-	29,848	29,848	-	6,717	6,717
Roosevelt	-	1,021	1,021	-	357	357
Sheridan	-	67	67	-	98	98
Teton	196,978	4,098	201,076	127,114	1,201	128,315
Toole	-	6,494	6,494	1,289	2,177	3,466
Valley	1,586	44,263	45,849	1,023	10,344	11,367
Wibaux	-	903	903	-	315	315
Total	348,754	250,242	598,996	217,659	70,253	287,912
Percent of total	58.2	41.8	100.0	75.6	24.4	100.0

1/ Trees 11.0 inches and larger in diameter as measured by International 1/4" rule.

2/ The volume, excluding bark, of sound trees and the sound volume of cull trees from stump to a 4.0-inch minimum top diameter including the sound volume of limbwood for hardwood species to a 4.0-inch minimum top diameter.

STANDARD STATISTICAL DATA FOR UNIT
NORTHERN MONTANA

Table 3. Land area by major use

Major use	Acres	Percent
Forest land	983,314	3.1
Nonforest land	30,731,246	96.9
Total	31,714,560	100.0

Table 4. Forest land area by class

Forest land class	Acres		Percent
Commercial forest land		624,526	63.5
Noncommercial forest land			
Withdrawn 1/	95,269		
Other 2/	263,519	358,788	36.5
Total		983,314	100.0

1/ Commercially valuable forest land actually withdrawn from commercial use for parks, reserves, wilderness areas, etc.

2/ Remote and inaccessible alpine areas, and other land which owing to very low productivity, excessively poor quality timber, or extreme inaccessibility appears to be permanently out of the commercial timber producing class.

Table 5. Commercial forest land by forest type and stand-size class

Forest type and stand-size class	Acres	Percent
Softwood		
Saw timber	67,035	10.7
Pole	117,213	18.8
Seedling-sapling	32,650	5.2
Poorly stocked and denuded	249,723	40.0
Total	466,621	74.7
Hardwood		
Saw timber	53,007	8.5
Pole	92,697	14.8
Seedling-sapling	10,182	1.7
Poorly stocked and denuded	2,019	.3
Total	157,905	25.3
Total		
Saw timber	120,042	19.2
Pole	209,910	33.6
Seedling-sapling	42,832	6.9
Poorly stocked and denuded	251,742	40.3
Total	624,526	100.0

Table 6. Board-foot volume on commercial forest land by species

Species	Volume	
	M board feet	Percent
Softwood		
Ponderosa pine	48,243	8.1
Douglas-fir	105,833	17.7
Alpine fir	21,756	3.6
Spruce	106,934	17.8
Lodgepole pine	51,552	8.6
White bark and limber pine	14,436	2.4
Subtotal	348,754	58.2
Hardwood		
Green ash	275	0.1
Aspen	491	.1
Cottonwood	249,239	41.6
Boxelder	157	1/
Willow	75	1/
Elm	5	1/
Subtotal	250,242	41.8
Total	598,996	100.0

1/ Less than 0.1 percent.

Table 7. Cubic-foot volume on commercial forest land by species

Species	Volume	
	M cubic feet	Percent
Softwood		
Ponderosa pine	36,610	12.7
Douglas-fir	77,019	26.8
Alpine fir	19,722	6.9
Spruce	29,188	10.1
Lodgepole pine	45,446	15.8
White bark and limber pine	9,336	3.2
Juniper	338	.1
Subtotal	217,659	75.6
Hardwood		
Green ash	2,619	0.9
Aspen	6,928	2.4
Cottonwood	60,366	21.0
Boxelder	304	.1
Willow	31	1/
Elm	5	1/
Subtotal	70,253	24.4
Total	287,912	100.0

1/ Less than 0.1 percent.

Table 8. Board-foot volume on commercial forest land by stand-size and tree-diameter classes

Stand-size class	Volume by tree-diameter class		
	12 - 18 inches	20 inches and larger	Total
	M board feet		
Saw timber	322,811	205,604	528,415
Pole	41,890	435	42,325
Seedling-sapling	5,664	-	5,664
Poorly stocked and denuded	22,290	302	22,592
Total	392,655	206,341	598,996

Table 9. Cubic-foot volume on commercial forest land by stand-size and tree-diameter classes

Stand-size class	Volume by tree-diameter class		
	12 - 18 inches	20 inches and larger	Total
	M cubic feet		
Saw timber	134,189	38,904	173,093
Pole	79,059	177	79,236
Seedling-sapling	2,482	-	2,482
Poorly stocked and denuded	33,038	63	33,101
Total	248,768	39,144	287,912

Table 10. Cubic-foot volume on commercial forest land by species group, tree size, and class of material

Source	Volume		
	Softwood	Hardwood	Total
	M cubic feet		
Saw-timber trees			
Sawlog portion 1/	61,416	38,690	100,106
Other 2/	13,166	13,598	26,764
Subtotal	74,582	52,288	126,870
Pole trees 3/	143,077	17,965	161,042
Total	217,659	70,253	287,912

1/ Sound trees only.
2/ Upper stems of sound trees, usable volume of cull trees, and limb-wood of hardwood species.
3/ Sound and cull trees.

Table 11. Average volume per acre by stand-size class

Stand-size class	Average volume per acre	
	Board feet	Cubic feet
Saw timber	4,402	1,442
Pole	202	377
Seedling-sapling	132	58
Poorly stocked and denuded	90	131
All stands	959	461

DEFINITIONS

Following are definitions of terms used in this report:

Area Classes

Forest land is land bearing forest growth or land from which the forest has been removed but which shows evidence of past forest occupancy and which is not now in other use.

Commercial forest land is forest land bearing or capable of bearing timber of commercial character and economically available now or prospectively for commercial use and not withdrawn from such use.

Noncommercial forest land is (1) commercially valuable forest land actually withdrawn from commercial use for parks, reserves, wilderness areas, etc., and (2) remote and inaccessible alpine areas, and other land which owing to very low productivity, excessively poor quality timber or extreme inaccessibility appears to be permanently out of the commercial timber-producing class.

Softwood forest consists of stands with 25 percent or more of ponderosa pine or 50 percent or more of other coniferous species. (Based on cubic-foot volume.)

Hardwood forest consists of stands with less than 25 percent of ponderosa pine and 50 percent or more hardwood species. (Based on cubic-foot volume.)

Stand-size Classes

Saw-timber stands include stocked areas with a plurality of the total net cubic volume in trees 11.0 inches and larger in diameter and generally with 2,000 board feet per acre or more in saw-timber trees.

Pole stands include stocked areas in which a plurality of the total cubic-foot volume is in trees from 5.0 inches in diameter to saw-timber size.

Seedling-sapling stands include stocked areas in which the plurality of the total cubic-foot volume is in trees less than 5.0 inches in diameter.

Poorly stocked and denuded stands include areas with less than: (a) 2,000 board feet per acre, (b) 10 percent stocking of pole trees, and (c) 40 percent stocking of seedling-sapling trees.

FOREST SURVEY METHOD

A. The forest resource statistics in this report are based on a field survey made during 1947. Briefly the method used in making this survey was as follows:

1. The forest area was determined by an area sampling system which involved measuring and classifying systematically distributed sample segments.

2. The timber volume was determined by measuring the trees found on randomly selected one-fifth acre plots located within the sample segments.

B. The basic data from which the area and volume were determined consisted of the following field samples:

Class	Area		Volume	
	Number of sample segments	Area per sample segment (acres)	Number of plots	Area per sample plot (acres)
I	37	2,560	111	1/5
II & III	96	640	192	1/5

C. Distribution of the area sample segments and volume plots was controlled by the following method:

1. The entire area was divided on 1-inch-to-the-mile base maps into three primary classes:

Class I Areas predominantly forest for which aerial photographs were available.
Class II Areas predominantly nonforest for which aerial photographs were available at moderate cost.
Class III Areas predominantly nonforest for which aerial photographs cost more than $2 per print, or for which there were no aerial photographs.

2. Each of the three primary classes were further subdivided into units in the following manner: Beginning with a random selection, Land Office section corners were marked on a base map at 4-mile intervals for areas in Class I, 7-mile intervals

for areas in Class II, and 10-mile intervals for areas in Class III. Thus, the three classes were subdivided into units containing approximately 16, 49, and 100 square miles respectively, each unit centered on one of the section corner control points.

3. The control points were transferred to aerial photo index maps from which photographs were selected to give photo coverage for a segment of each unit containing forest land. For Class-I units the sample segments consisted of four Land Office sections (2,560 acres) centered on the control point, for Class-II and -III units the sample segments consisted of one section (640 acres) lying northeast of the control point.

4. All sample segments containing commercial forest land, including those with doubtful forest cover by photo interpretation and all sample segments without aerial photographs, were examined and mapped in the field. For each sample segment the forest cover was stratified by commercial character, forest type, stand-size, stocking, age, and site classes. The area of these stratifications was determined from the mapped sample segments and as refined by line transects was multiplied by a sample factor (the area of a class divided by the area as computed for the sample segments) to get the total area by forest condition classes.

5. Timber volume was tallied on three 1/5-acre sample plots in each sample segment of Class I, and two 1/5-acre plots in the sample segments of Classes II and III. The plots were randomly located within the sample segments. Plot volumes when averaged for a given forest condition were multiplied by the area to determine the total timber volume.

ACCURACY OF THE DATA

In determining the extent of various cover types and stand-condition classes, there are two possible sources of error: (1) errors in classifying the cover of the field samples and in compiling the field data, and (2) sampling errors. The former result from mistakes of judgment or technic and the complexity of the cover which not infrequently grades from one class into another with no clearly defined boundaries. These errors were minimized by the exercise of care and skill, but it is seldom possible to evaluate them. An effort was made to maintain a high order of accuracy and uniformity of standards in the classification, collection, and compilation of sample data, by field checks, by a continuing program of training, and by cross checks in the office.

Sampling errors (standard errors of estimate) on the other hand do not involve human errors but rather are theoretical measures of the reliability of estimates based on the variability exhibited by sample measurements. They generally vary inversely with the square root of the number of samples and directly with the square root of the unsampled proportion of the total population. Hence, they can be controlled by altering either the number of samples, the size of individual samples, or both.

Analysis of sample variations in the unit indicate that the standard errors of estimate for the unit are ± 1.0 percent for total forest land area and ± 3.1 percent for commercial forest land area. Accordingly, the probabilities are 2 out of 3 that the actual forest land area and commercial forest land area are, respectively, within ± 10,000 acres and ± 19,000 acres of the estimated areas if measurements and computing errors introduced no bias.

In determining timber volumes, the possible sources of error include in addition to those cited above (3) inaccurate measurement of sample plots, tree diameters, tree heights, and cull, and (4) bias resulting from improper construction, selection, and use of tree-volume tables. All reasonable effort was made to eliminate errors from these sources. The standard error of the board-foot volume estimate for the block as a whole is ± 16.2 percent and of the cubic-foot volume estimate, ± 8.6 percent. Accordingly, the probabilities are 2 out of 3 that the actual volumes are within ± 97,037 M board feet and ± 24,760 M cubic feet of the given estimates.

The reliability of one statistic as compared with another presented in the same or a related table can be judged roughly by its relative magnitude. In general, the larger quantities warrant greater confidence; the smaller quantities indicate only relative magnitude. This fact should be borne in mind in considering the small quantities associated with many of the counties covered in this report.

LIST OF FOREST SURVEY REPORTS FOR MONTANA

No.	Forest Survey Statistical Service Series
2	Forest statistics for Lincoln County, 1941.
3	Forest statistics for Flathead County, 1941.
4	Forest statistics for Lake County, 1941.
5	Forest statistics for Sanders County, 1941.
6	Forest statistics for Mineral County, 1941.
7	Forest statistics for Ravalli County, 1941.
8	Highlights of the Missoula County forest situation, 1942.
9	Highlights of the forest situation in Lewis and Clark County (west of the Continental Divide), 1942.
10	Highlights of the forest situation in Deerlodge County (west of the Continental Divide), 1942.
11	Highlights of the forest situation in Silver Bow County (west of the Continental Divide), 1942.
12	Highlights of the Powell County forest situation, 1942.
13	Highlights of the Granite County forest situation, 1942.
14	Highlights of the forest situation in western Montana, 1943.
15	Highlights of the forest situation in Chouteau County, 1943.
16	Highlights of the forest situation in Fergus County, 1943.
17	Highlights of the forest situation in Judith Basin County, 1943.
18	Highlights of the forest situation on the national forests of western Montana, 1944.

Forest Survey Releases

20	The forest situation in Lincoln County, July 1943.
21	The forest situation in Ravalli County, July 1943.

Station Papers

12	Forest resource statistics Cascade County, by H. J. Pissot and E. F. Peffer, April 1948.
13	Forest resources of Northern Montana, by C. W. Brown and W. C. Hodge, June 1948.

LIST OF PREVIOUS PUBLICATIONS IN THIS SERIES

Station Paper No.	
1	* A preliminary study of root diseases in western white pine, by John Ehrlich. Oct. 1939.
2	* Possibilities of partial cutting in young western white pine, by E. F. Rapraeger. Jan. 1940.
3	Blister rust control in the management of western white pine, by Kenneth P. Davis and Virgil D. Moss. June 1940.
4	Possibilities of wood-pulp production in the northern Rocky Mountain region, by E. F. Rapraeger. Mar. 1941.
5	Results to date of studies of the durability of native woods treated and untreated, by C. N. Whitney. Rev. Jan. 1946.
6	Changes in Benewah County forest statistics, by Paul D. Kemp. July 1947.
7	A guide for range reseeding on and near the national forests of Montana, by C. Allan Friedrich. Oct. 1947.
8	Pole blight - a new disease of western white pine, by C. A. Wellner. Nov. 1947.
9	Management practices for Christmas tree production, by C. A. Wellner and A. L. Roe. Nov. 1947.
10	The merits of lodgepole pine poles, by I. V. Anderson. Nov. 1947.
11	Tables for approximating volume growth of individual trees, by P. D. Kemp and M. E. Metcalf. Mar. 1948.
12	Forest resource statistics, Cascade County, Montana, by H. J. Pissot and E. F. Peffer. Apr. 1948.

* Out of print. Loan copies may be obtained upon request.